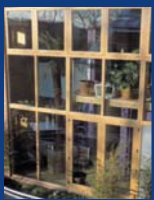
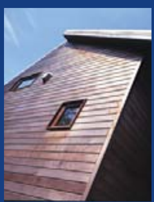
Architect's Guide to



Sustainable Design and Construction



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Contents

1 Introduction

We all want to improve the quality of life in London and this guidance highlights the important contribution made by those involved in the design and construction of new developments. It is important to create developments that are more cost effective to run, more secure, and that minimise their environmental impact and provide healthy living conditions, while respecting the area's rich heritage and distinctiveness.

This document is intended as a guide for architects and contractors when undertaking new development. Careful consideration of design and specification at an early stage can provide significant savings compared with an ad hoc approach and proposers of development will benefit at the planning stage if they understand the principles of sustainable design and construction prior to commencing the design work.

The development of this document has been informed by the Mayor of London's Supplementary Planning Guidance on Sustainable Design and Construction, which provides guidance to local planning authorities, architects and developers on how to meet London Plan policy for developments that are referable to the Mayor.

Many planning authorities are now requiring that developments gain a rating under Code for Sustainable Homes methodology, this guide therefore shows the mandatory requirements of the Code and where there are opportunities to gain further credits.

Feasibility

- Appoint BREEAM Assessor (where applicable)
- Appoint ecologist
- Appoint environmental consultant
- Is there scope for renewables?
- Location: public transport and utilities
- Site conditions: geology, ecology and contamination

Planning and Design

- Building form and orientation: maximise daylight
- Cycle storage space
- Internal recycling facilities
- Material specifications
- Specification of resource and energy efficient services (heating, ventilation, water, etc)
- Building Green

Construction

- Considerate Constructors Scheme
- Waste management
- Air quality
- Protecting biodiversity

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The drivers for sustainable design and construction

There are now many factors encouraging designers and developers to adopt more sustainable design and construction practices:

- Those companies that adopt forward thinking approaches will increase opportunities for developing on sites being brought forward by informed landowners (for example regional development agencies) and building clients
- Growing awareness from shareholders, investors and the public has led to increased public reporting on social and environmental issues, with some developers now producing annual environmental, social or sustainability reports
- Socially responsible investment has placed pressure on companies to integrate social and environmental considerations into their working practices, and to adopt environmental management systems, creating greater pressure from clients for buildings with reduced running costs and more attractive and healthy working environments for their staff
- There is growing recognition that creating decent places for people to work and live, with high quality public spaces and amenities creates value and will lead to higher investment returns for developers.
- Planning authorities are setting increasingly high standards for sustainability, adopting a strong sustainability strategy for all developments will save time and money when sustainability is required on individual developments
- The Government in conjunction with BRE released the Code for Sustainable Homes rating scheme in April 2007, it is expected that this will become a mandatory requirement in a few years and Code Level 3 is already stipulated by the Housing Corporation and English Partnerships for developments built on their land

3 Putting a price on sustainability

It is commonly assumed that incorporating sustainability features into a development will greatly increase the costs of a building project. The BRE and Cyril Sweett study Putting a Price on Sustainability 2005 contradicts this assumption and illustrates that significant improvements in performance can be achieved at very little additional cost.

As part of the study, the costs of achieving enhanced and exemplar environmental performance were investigated for four types of building:

- Ventilated office
- Air conditioned office
- Domestic dwelling
- Healthcare centre

These buildings were chosen to represent Building Regulations-complaint, typical industry projects in the UK. BRE's suite of BRE Environmental Assessment Method (BREEAM) tools were used to determine benchmarks of environmental performance.

In the BREEAM scheme, several credits are available for aspects of the site and its location. These include proximity to local amenities and public transport, existing ecological value and whether the site has been previously built upon. In the study the following three location scenarios were assessed:

- Poor location (where no location credits are achievable)
- Typical location (where a selection of credits are achievable; a brownfield site with limited access to local amenities and public transport, in an edge of town location)
- Good location (where all location credits are achievable)

An overview of the study results, including the percentage increase on base build cost for meeting a BREEAM pass, good, very good or excellent rating are provided in Appendix D.

Findings illustrated that reaching the highest standards does incur costs, but careful consideration of design and specification at an early design stage can provide significant savings compared with an ad hoc approach. Low- or no-cost options identified, included:

- Specifying water efficient appliances
- Ensuring all timber is procured from sustainably certified sources
- Committing to good construction practice (such as the Considerate Constructors Scheme - see section 8 for further information)
- Providing low energy lighting
- Incorporating the principles of passive solar design

The complete findings of this study have been published in a BRE Trust report entitled Putting a Price on Sustainability (FB10) and is available from the BRE bookshop: **www.bre.co.uk**

A second report 'Eco Chic or Eco Geek: The desirability of Sustainable Homes' has been published by the SPONGE Sustainability Network which indicates the premiums that developers can achieve by building sustainable homes. The main findings were:

- 52% of homebuyers are prepared to pay more for a sustainable home
- 92% of homeowners would like sustainability features offered as options on new homes, 64% of homeowners think these features should be compulsory
- 73% of homebuyers think energy efficient or water saving features would be fairly or very important when choosing their next home
- 2/3rds of homeowners would be prepared to pay a monthly charge for sustainability services

The executive summary of this report is available from **www.spongenet.org/lifestyle/**

4 How to use this guide

This guide discusses the themes of sustainable design and construction and illustrates the requirements of the Code for Sustainable Homes

This guide does not contain case studies. Case studies relating to sustainable design and construction can be found in Appendix D of the Mayor of London's Supplementary Planning Guidance on Sustainable Design and Construction **www.london.gov.uk**

Proposers of all development should submit a sustainable design and construction proposal with their planning application, in order to strengthen their case.

This guide is not intended to tell designers how to design or what a sustainable building should look like. It has been created in order to highlight the key principles of sustainable design and the expectations of the Greater London Authority and many local planning authorities with regard to the information on sustainable design and construction that should be supplied with planning proposals.

Certain developments are referable to the Mayor and will be required to comply with policy contained within the Mayor's Spatial Development Strategy, the London Plan. To find out more about the London Plan and development criteria for strategic referrals, visit **www.london.gov.uk**.

The Mayor's Climate Change Action Plan: *Action Today to Protect Tomorrow* should also be considered when planning new developments. **http://www.london.gov.uk/mayor/environment/climate-change/docs/ccap_fullreport.pdf**

5 Sustainability appraisal methodologies and checklists

There are a range of sustainable development appraisal methodologies and checklists available, including BREEAM. It is becoming a standard requirement by local planning authorities for new developments to meet a BREEAM[1] standard:

- Residential developments can be assessed by the Code for Sustainable Homes methodology
- Major non residential development can be assessed by BREEAM

[1] BREEAM is a widely accepted as a benchmark for measuring environmental performance. It offers independent assessment of a proposal using a range of criteria for which credits are given to reward positive steps taken. BRE/ICE have developed a civil engineering companion assessment tool.

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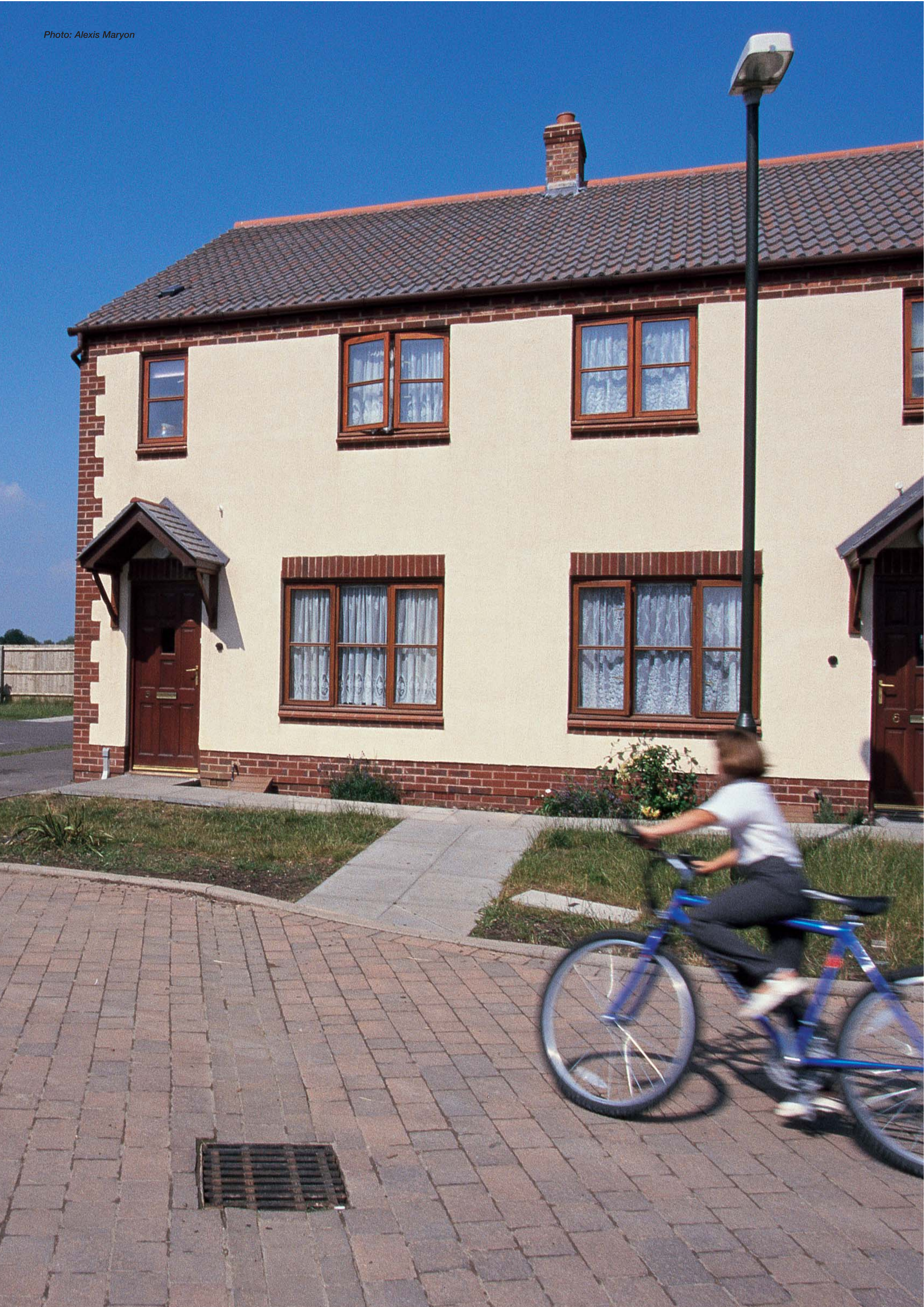
The key themes of sustainable design and construction

This guide addresses the following key themes of sustainable design and construction:

- Sustainable Design
  - Ensuring land is safe for development
  - Ensuring access to and protection of the natural environment
  - Reducing negative impact on the local environment
  - Conserving natural resources and reducing carbon emissions
  - Conserving economic and social well-being
- Sustainable Construction
  - Applying the principles of sustainability to the construction process

In addition to sustainable design and construction, this guide also describes how proposers of development can facilitate sustainable living, through provision of facilities such as cycle storage and recycling spaces and information on services operation (heating, water, ventilation, etc) for building occupiers.

Photo: Alexis Maryon



7

Sustainable Design

7.1 Ensuring land is safe for development

Throughout the UK there are thousands of sites that have been contaminated by previous use. Often this is associated with industrial processes or activities that have now ceased, but where waste products or remaining residues present a hazard to the general environment.

In London it is imperative that land is reused for development rather than development of green-field sites such as parks or woodland. As such, the development of contaminated sites may occur.

Proposers of development on potentially contaminated sites should arrange pre-application discussions with the planning department and other regulators, including the Environmental Health and Building Control departments of the local council, the council's archaeological and nature conservation advisers and the Environment Agency (where pollution of controlled water and the waste management implications of land contamination are likely to be issues). Such discussions can help to identify the likelihood and possible extent and nature of contamination and its implications for the development being considered. They can also assist in scoping any necessary environmental impact assessment and identify the information that will be required by the council to reach a decision on the application when it is submitted.

The DETR Circular 2/2000 Contaminated Land: Implementation of Part IIA of the Environmental Protection Act 1990 gives statutory guidance on the new regime for the treatment of contaminated land, as set out in Part IIA of the Environmental Protection Act 1990.

7.1.1 Remediation of contaminated land

Many early reclamation schemes in the UK relied on the use of cover systems to limit exposure to contaminants at the surface of a site. The construction of physical barriers can represent a relatively simple low-cost reclamation strategy, but is a predominantly cosmetic exercise that simply conceals contamination and results in property blight and increased liability.

Alternative techniques such as bio-remediation, soil vapour extraction and soil washing are established in the UK and are frequently cheaper than disposal. Therefore, there will be a general favouritism for on-site treatment expressed by local councils. The Environment Agency will also generally be consulted when these remediation techniques are considered.

Bioremediation treats the contamination in situ, obviating the need to excavate and remove large quantities of materials. The technique is based around introducing microbes into the soil that eat the contamination over a period of months. It is particularly successful in the treatment of hydrocarbon contamination, often found on redundant garage and car breakers sites.

In most cases, bioremediation is not the single answer to a contamination problem, but should be considered as part of an overall reclamation strategy. Bioremediation is very effective in permeable, sandy soils or gravels. It is less effective in heavy clays where it is difficult to break down the soil structure to one amenable to oxygen transfer and biodegradation activity.

Bioventing - this can be used to biodegrade contaminants above the water table, in the unsaturated zone. Extra oxygen is supplied through one or more monitoring wells fitted with perforated pipes, to improve conditions for degradation. Contaminant vapours are removed through peripheral boreholes, which promote airflow through the contaminated soil. Nutrients can be added to improve degradation.

Biosparging - this is effective in the saturated zone below the watertable. Air is injected into the saturated zone through boreholes finished with screened wells. It then forms small bubbles in the groundwater, encouraging the dissolution of oxygen and the movement of air towards the surface. As the air rises, it picks up the volatile compounds in the groundwater and transfers them to the unsaturated zone.

Injection and recovery (pump and treat) - this effectively creates the conditions of a bioreactor in the treated medium. Contaminated groundwater is pumped to a treatment tank on the surface where nutrients and oxygen, along with other treatment substances such as sulphate and nitrate are added. The partially treated groundwater is pumped back into the contamination zone, where it stimulates microbial activity[2].

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[2] Data Source: Environment Business Magazine (June 2002)

7.2 Ensuring access to and protection of the natural environment

Open and green spaces can contribute to a positive image and vitality of areas. As London becomes more compact and intensive in its built form, the value of these open spaces will increase. Open spaces will need to fulfil a multitude of functions, from educational to social and cultural to sport and recreation as well as visual respite from the hard urban areas.

Urban green space has a number of beneficial impacts on the microclimate of our towns and cities where the consequences of climate change will be most severe. By creating daytime shade and evaporative cooling at night, green space can moderate the urban heat island effect. With greater precipitation expected during winter months, green spaces will absorb storm waters, thereby helping to lower the risk of urban flooding.

Green spaces and water spaces occupy two-thirds of London's land area and encompass a diverse range of natural environment. Of this, about a third of the total area is in private gardens, a third in parks or in sports use and a further third is in a wide range of other categories, including much wildlife habitat. These open spaces support over 1500 species of flowering plants and 300 types of birds. The diversity of wildlife they support adds to people's enjoyment of these areas.

Code for Sustainable Homes: Health and Wellbeing

Hea3: Private Space

A credit is awarded if a private or communal private space is provided for residents of the development. 1m2 per person is required.

Code for Sustainable Homes: Ecology

Eco1: Ecological Value of the Site

Credits are awarded for developing on sites of low ecological value, as assessed by a qualified ecologist.

Eco2: Ecological Enhancement

A suitably qualified ecologist should be employed and all their key recommendations should be adopted. Additional credits are awarded if 30% of their other recommendations are also adopted.

Eco3: Protection of Ecological Features

If the site has features of ecological value then protection of these during site clearance, preparation and construction works warrants 1 credit.

Eco4: Change of Ecological Value of the Site

Up to 4 credits can be gained if the number of species present on the site is increased once the development is built, this would need to be verified by an ecologist.

Eco5: Building Fabric

Credits are awarded for building high density developments:

Ratio of net internal floor area: Net internal ground floor area	**Credits**
Houses - 2.5:1, Flats - 3:1	1
Houses - 3:1, Flats - 4:1	2

7.2.1 Open space

Enabling easy access to the natural environment

The design of new development should:

- Identify opportunities to improve access to and the accessibility of open spaces, through support for public transport, cycling, walking and improving access and facilities for disabled people.
- Identify opportunities for improving linkages between open spaces and the wider public realm.
- Ensure that the open space can be used and owned by the community (e.g. provision of allotments and access to green space for those without gardens)
- Make use of interpretation to help improve accessibility and foster understanding and ownership of common land.
- Ensure convenient and enjoyable access to nature by prioritising increases in biodiversity where sites are within or near to areas deficient in accessible wildlife sites.

Providing new and enhanced green spaces to serve the community

Where development is taking place within an identified area of open space deficiency development presents an ideal opportunity to create new publicly accessible open space. You can assess how your development meets this requirement using the London's Open Space hierarchy (London Plan Table 3D.1) . A growing requirement of residents is the provision of play-space for children on a development.

Code for Sustainable Homes: Health and Wellbeing

Hea3: Private Space

A credit is awarded if a private or communal private space is provided for residents of the development. 1m2 per person is required.

Photo: Courtesy of Renewable Energy Association

7.2.2 Natural environment and biodiversity

With a few simple steps, developers can ensure that they improve the aesthetic qualities of their site and comply with biodiversity legislation. An overview of the process by which developers can achieve these objectives is presented in the design for biodiversity guidance available at: www.d4b.org.uk/policiesAndGuidance/index.asp. It is produced by the LDA and outlines the critical drivers and principle processes which promote industry best practice.

All developments can be improved if the Design for Biodiversity sequential tests are applied:

- Retain, enhance or create features of nature conservation value and avoid harm
- Mitigate for impacts to features of nature conservation value
- Compensation for the loss of features of nature conservation value

Green roofs

All development can incorporate opportunities for biodiversity whatever their relationship to existing habitats and species. Climbing plants, green walls, green roofs, roof gardens, terraces, balconies, courtyards, permeable surfaces, living fences, pergolas, arbours, window boxes and nesting and roofing structures will all facilitate the creation of new habitats.

With the exception of green roofs, all other green building techniques should be well known to developers. Green roofs are vegetated roofs, or roofs with vegetated spaces and are also referred to as eco-roofs and roof gardens. Green roofs have been with us for centuries ranging from the hanging gardens of Babylon to the turf roofed dwellings of Ireland and Scandinavia. Modern green roofs have largely developed in the last 50 years, with increasing sophistication to meet a growing range of needs.

Most of this technological advance has been made in Germany; demand in the 1970s and 1980s has lead to a £39 million industry. The modern green roof systems are highly durable and in addition to encouraging biodiversity, provide a number of key sustainability and environmental benefits:

- Extended roof life - green roof protects waterproofing membrane from climatic extremes
- Energy conservation/ fuel bill savings through insulating properties
- Reduction in heat island effect through evaporative cooling
- Reuse of aggregates provides a cost saving - a 1000m^2 green roof could provide a £10,000 saving on the cost of materials[3]
- Improved aesthetics for the area
- Noise amelioration, again through insulation properties
- Improved air quality and health benefits
- Reduction in surface water run-off and drainage costs - the soil provides temporary storage of storm water, which drains off slowly, or is captured by the roots of the plants or leaves and then evaporates

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[3] Data Source: http://www.livingroofs.org

7.3 Reducing negative impact of development on the local environment

Increased densities and mixed uses are needed to meet certain sustainability criteria. However design needs to address the associated risks of this type of development increasing other adverse effects on the local environment, such as noise, air, light and water pollution and negative microclimate effects.

7.3.1 Noise

Excessive noise can impact upon health, productivity and quality of life at home, in the workplace or at school. There are a number of design and layout principles that can reduce the adverse impacts of noise. The balance between noise reduction and other needs should be struck on a place-specific basis, taking account of potential changes in noise sources, and in competing needs, over the lifetime of the development.

Principles for layout design

Sound quality - the overall soundscape should be considered at the early design stage, identifying any sound features or 'soundmarks' of special interest e.g. flowing water.

Noise mitigation through good design - Local Environmental Health Officers (EHOs) can impose construction phase and operational noise limits on many types of noise at any time. Noise limits are much easier to comply with if taken into account in the design and planning stage and many can be addressed at the design stage through optimising the site layout. Uses likely to generate significant noise should be separated from those areas requiring quiet, by the greatest practical distances. Where this is impractical, uses likely to generate greatest noise should be separated from areas requiring quiet by screening, isolation or other acoustic design methods.

Noise generating activities - Noise generating activities should be identified and low noise alternatives used where practicable. (Sources of noise generating activities include air handling equipment, pumps, fans, vehicle manoeuvre, loading/unloading, etc.) Human voices can cause nuisance - for example, school playgrounds, sporting venues and late night entertainment

Building design and internal layout

Building over noise sources - such as railways, roads, car parks, bus depots, etc. can be an effective way of designing out noise, although such sites can be expensive to develop and there can still be a problem on exiting or entering a building. Surfaces within openings may need to be sound absorbing to avoid reverberation increasing noise levels. Special attention is needed to prevent both airborne and structure-borne noise.

Planning of buildings and rooms - buildings and rooms whose uses are not susceptible to noise should be located to act as screens or baffles between noise sources and quiet areas. Also there is a need to consider juxtaposition in 'stacking' for example placing bedrooms of one flat below the living area of another flat is likely to generate noise problems. Windows or ventilation system design should incorporate acoustic features to address noise, especially at night.

Façade continuity - High-density development following traditional street blocks, including noise barriers that fill in the gaps between buildings can significantly reduce noise on the 'quiet side' of the street block. However, façade reflectivity (reflection between opposing, acoustically hard building surfaces) increases noise levels, particularly in 'urban street canyons' and façades at the wrong angle can reflect sound into quiet areas. In compact urban environments, the use of absorptive barrier surfaces is preferable to inclining surfaces to reflect sound upwards.

Tightly-enclosed spaces between buildings - these can be tranquil, but can also 'trap' sound, including that emanating from poorly designed, installed or maintained ventilation plant, waste facilities, vehicle manoeuvring, neighbours, or aircraft. Acoustic absorbency within 'courtyard' areas should normally be maximised, by, for example, use of dense vegetation and acoustically soft ground. The balance of advantage between contained and more open layouts depends on the relative contributions of different noise sources.

Tall buildings - may receive noise from a wider area than lower ones. Acoustic balconies for example with absorptive surfaces to avoid reflection off the underside into windows below, and stepping back of the upper floors can provide significant benefits.

Positioning of building services - building services such as air extract ducting should be positioned away from sensitive windows and properties and be isolated from the structure to prevent structural noise. Particular care should be taken to avoid or attenuate fan and vent noise on the 'quiet side' of buildings with passive alternatives sought wherever possible.

Noise insulation - except where local soundscape quality is high or can be improved, good practice includes achieving noise insulation standards beyond those required by Building Regulations and Planning Policy Guidance 24, particularly for roofs, glazing and party walls and floors. Lobbies with two sets of doors creating an air lock can reduce the escape of sound for example, from late night entertainment premises.

Selection of materials - materials with a higher density normally provide greater resistance to the passage of airborne sounds, but may be vulnerable to impact noise particularly if hard surfaces are used. Composite or sandwich constructions may be specified to perform a variety of acoustic functions.

7.3.2 Air pollution

Reducing emissions from the use of the building are largely brought about via methods used to improve energy efficiency. However, in addition to ensuring the highest standards of energy efficiency, proposers of development should ensure that the building services plant:

- Has the lowest emissions possible
- Will not present a health risk

Improving the efficiency of plant will generally lead to lower emissions; approximately 20 per cent of the oxides of nitrogen emitted in London are directly from buildings, mainly from the burning of natural gas. Low NOx burners should be used whenever practicable, however if biomass boilers are installed these will have a higher NOx emission rating than a standard gas condensing boiler.

Building services should be readily accessible so that they can be easily maintained and regularly checked and cleaned to ensure they are operating efficiently and do not present a health risk. Emissions of carbon monoxide are a particular issue.

Code for Sustainable Homes: Health and Wellbeing

HEA2 Sound Insulation

Credits are awarded for the insulation of a property against noise pollution. The performances required below should be assessed using either Robust details or pre-completion sound testing.

Level of sound insulation achieved	Credits
Airbourne 3dB higher, impact 3dB lower	1
Airbourne 5dB higher, impact 5dB lower	3
Airbourne 8dB higher, impact 8dB lower	4
Detached property	4
Separating walls and floors only occur between non-habitable spaces	3
Separating walls and floors only occur between habitable and non-habitable spaces	3
Separating walls and floors only occur between non-habitable spaces	3
Separating walls and floors only occur between habitable and non-habitable spaces	3

Code for Sustainable Homes: Pollution

Pol1: NOx Emissions

Boilers that have low NOx emissions should be specified to gain credits under Pol1, as shown in the table below. Where biomass boilers are specified very low NOx ratings are not usually achievable.

NOx Emissions of Boiler	Credits
Greater than 100mg/kWh	0
Less than 100mg/kWh	1
Less than 70mg/kWh	2
Less than 40mg/kWh	3
Class 4 boiler	1
Class 5 boiler	2

Photo: Courtesy of The Guinness Trust

7.3.3 Light pollution

Light pollution has emerged as a significant issue in populated areas. Light pollution obscures the night sky, is wasteful of energy and can disrupt the lives of people living in and around new developments. Public safety requires that highways and public areas are lit up at night, but by using directional lighting, both light pollution and energy costs can be reduced.

A positive approach to the problem of excessive lighting

Effective illumination should be well directed and almost invisible from a distance. The lighting scheme should not exceed that which is required for the satisfactory undertaking of the task involved.

Proper design and planning - It is possible to reduce many of the negative effects of lighting through proper design and planning, using lighting only where and when necessary, using an appropriate strength of light and adjusting light fittings to direct the light to where it is required. Illuminance should be appropriate to the surroundings and character of the area as a whole. Avoid 'over lighting' and use shields, reflectors and baffles to help reduce light spill to a minimum. Use specifically designed equipment that once installed minimises the spread of light above the horizontal.

Direction of light - Direct light downwards wherever possible to illuminate its target, not upwards. Many floodlit buildings are lit from the ground with the beams pointing into the sky. This often leads to columns of stray light pointing up into the sky creating vast amounts of light pollution and wasting energy. Provide lighting that does not glare on approach and which places light onto the ground and not into the sky where it is wasted. In other cases, simply lowering the angle of the beam will stop light from overshooting the building into the sky.

To keep glare to a minimum, ensure that the main beam of all lights directed towards any potential observer is kept below 70 degrees. It should be noted that the higher the mounting height, the lower the main beam angle should be. In places with low ambient light, glare can be very obtrusive and extra care should be taken in positioning and aiming. Wherever possible use floodlights with asymmetric beams that permit the front glazing to be kept at or near parallel to the surface being lit.

Sensor switches - For domestic and small scale security lighting use 'Passive Infra Red Sensors' (PIR). If correctly aligned and installed, a PIR Sensor that switches on lighting when an intruder is detected, often acts as a greater deterrent than permanently floodlit areas, which also allow the potential intruder to look for weaknesses in security i.e. open windows.

Types of lamps - Low pressure sodium (LPS) street lamps which scatter their orange light all around, including skywards, are a common sight along many streets and in residential areas. An increasingly popular alternative, however, is the full cut-off, high pressure sodium (HPS) lamp, although these are more expensive to install. Full cut-off lamps prevent any light from being emitted above the horizontal and the HPS creates a bright pinkish white light, which is carefully directed to avoid light trespass. In a recent survey, 85% of drivers stated that they prefer the light from HPS lamps. HPS lamps are the preference for lighting sports pitches for the same reasons.

Solar powered lighting

Wherever possible seek to use solar powered lighting. Solar powered lighting schemes can be installed at a significantly lower cost than grid-connected systems, while helping to meet London's greenhouse gas reduction targets through the use of renewable energy.

Code for Sustainable Homes: Energy

Ene6: External Lighting

To gain points under this credit all burglar security lighting should have

- Maximum wattage of 150W
- Movement detecting control devices
- Daylight cut-off sensors

All other security lighting should have:

- Dedicated energy efficient fittings
- Fitted with daylight cut-off sensors OR timers

7.3.4 Water pollution and flooding

Much of London is situated on a floodplain and tidal water levels in south east England are rising each year. Flash flooding can occur almost anywhere, especially in built up areas with a high proportion of impermeable surface. Predicted climate change with increases in storm episodes and sea level rises mean that it is vital that developers address a development's surface water run off.

By incorporating Sustainable Urban Drainage systems (SUDS) - as an alternative to traditional approaches to managing runoff from buildings and hard standing - the total amount, flow and rate of surface water that runs directly to rivers through storm-water systems can be greatly reduced, thereby preventing flooding incidents and pollution of waterways.

Implementation of SUDS can lead to cost savings such as avoiding or reducing the need to construct or access surface water sewers or pipe connections to distant outfalls. By using landscaping features that would already be provided as part of the site scheme (e.g. grassed amenity and car parking areas) SUDS offers further cost savings. Based on percolation drainage, SUDS may also control pollution for example by incorporating petrol and grease interceptors.

Wherever possible multiple benefits from SUDS should be sought, such as wildlife improvements and water conservation. SUDS should also be linked to large scale catchment based flood management. If SUDS cannot be provided on site, consideration should be given to making a contribution to off site SUDS.

The SUDS Technologies

Short of preventing surface-water run off through water conservation methods such as rainwater harvesting and grey-water recycling there are four general methods of control:

- Permeable surfaces and filter drains
- Filter strips and swales
- Infiltration devices
- Basins and ponds

Green roofs also reduce surface water run-off. The soil provides temporary storage of storm water, which drains off slowly, or is captured by the roots of the plants or leaves and then evaporates. See Section 5.2.2 for more information on green roofs.

Permeable surfaces and filter drains

In urban areas, impermeable hard surfacing, especially over a large ground area, can cause flooding. Filter drains and permeable surfaces are devices that have a volume of permeable material below ground to store surface water. Runoff flows to this storage area via a permeable surface. This can include:

- Grass (if the area will not be trafficked)
- Reinforced grass
- Gravelled areas
- Solid paving blocks with large vertical holes filled with soil or gravel
- Solid paving blocks with gaps between the individual units
- Porous paving blocks with a system of voids within the unit
- Continuous surfaces with an inherent system of voids

The water passes through the surface to the permeable fill. This allows the storage, treatment, transport and infiltration of water. Both the surface and the sub-base of a pavement must allow the passage of water - for this reason, porous asphalt laid on a conventional impermeable base is not a permeable pavement.

The amount of water stored depends on the voids ratio of the permeable fill or sub-base, the plan area and depth. Water can be disposed of by infiltration, an under-drain, or pumped out. Overflow can be via a high level drain or controlled surface flow. In some situations the water should not be stored for extended periods as it can affect the strength of the surrounding soil.

The permeable fill or sub-base traps sediment, thereby cleaning up runoff. Recent research shows that they also provide some treatment for other pollutants, such as oil.

The variety of surfaces is wide enough for a landscape architect to select a hard landscape style to suit the style of the development. By their nature, filter drains and permeable surfaces ensure an efficient use of space.

Filter Strips and Swales

Filter strips and swales are vegetated surface features that drain water evenly from impermeable areas. Swales are long shallow channels whilst filter strips are gently sloping areas of ground.

Both devices mimic natural drainage patterns by allowing rainwater to run in sheets through vegetation, thereby slowing and filtering the flow. Swales can also be designed for a combination of conveyance, infiltration, detention and treatment of runoff.

Swales are usually designed as conveyance systems, but can also be designed with check dams to increase attenuation and, where applicable, infiltration. Filter strips only attenuate the flow slightly but they can be used to reduce the drained impermeable area.

Photo: Courtesy of Renewable Energy Association

Swales and filter strips are effective at removing polluting solids through filtration and sedimentation. The vegetation traps organic and mineral particles that are then incorporated into the soil, while the vegetation takes up any nutrients.

Swales and filter strips are often integrated into the surrounding land use, for example public open space or road verges. Local wild grass and flower species can be introduced for visual interest and to provide a wildlife habitat. Care should be taken in the choice of vegetation as tussocks create local eddies, increasing the potential for erosion on slopes. Shrubs and trees can be planted, however, in this case the vegetated area will need to be wider and have a gentler slope.

Infiltration devices

Infiltration devices drain water directly into the ground. They may be used at source or the runoff can be conveyed in a pipe or swale to the infiltration area. They include soakaways, infiltration trenches and infiltration basins as well as swales, filter drains and ponds. Infiltration devices can be integrated into and form part of the landscaped areas.

Soakaways and infiltration trenches are completely below ground, and water should not appear on the surface. Infiltration basins and swales for infiltration store water on the ground surface, but are dry except in periods of heavy rainfall.

Infiltration devices work by enhancing the natural capacity of the ground to store and drain water. Rain falling onto permeable (e.g. sandy) soil soaks into it. Infiltration devices use this natural process to dispose of surface water runoff. Limitations occur where the soil is not very permeable, the water table is shallow or the groundwater under the site may be put at risk.

Infiltration techniques:

- Provide storage for runoff. In the case of soakaways and infiltration trenches, this storage is provided in an underground chamber, lined with a porous membrane and filled with coarse crushed rock. Infiltration basins store runoff by temporary and shallow ponding on the surface;
- Enhance the natural ability of the soil to drain the water. They do this by providing a large surface area in contact with the surrounding soil, through which the water can pass

The amount of water that can be disposed of by an infiltration device within a specified time depends mainly on the infiltration potential of the surrounding soil. The size of the device and the bulk density of any fill material will govern storage capacity.

Runoff is treated in different ways in an infiltration device. These include:

- physical filtration to remove solids
- adsorption onto the material in the soakaway, trench or surrounding soil
- biochemical reactions involving micro-organisms growing on the fill or in the soil

The level of treatment depends on the size of the media and the length of the flow path through the system, which controls the time taken for the runoff to pass into the surrounding soil. Pre-treatment may be required before polluted runoff is allowed into an infiltration device.

Infiltration systems are easily integrated into a site. They are ideal for use as playing fields, recreational areas or public open space. Infiltration basins can be planted with trees, shrubs and other plants, improving their visual appearance and providing habitats for wildlife. They increase soil moisture content and help to recharge groundwater, thereby mitigating problems of low river flows.

Basins and Ponds

Basins are areas for storage of surface runoff that are free from water under dry weather flow conditions. These structures include:

- Flood plains
- Detention basins
- Extended detention basins

Ponds contain water in dry weather, and are designed to hold more when it rains. They include:

- Balancing and attenuation ponds
- Flood storage reservoirs
- Lagoons
- Retention ponds
- Wetlands

The structures can be mixed, including both a permanently wet area for wildlife or treatment of the runoff and an area that is usually dry to cater for flood attenuation. Basins and ponds tend to be found towards the end of the surface water management train and are, therefore, used if source control cannot be fully implemented, if extended treatment of the runoff is required or if they are required for wildlife or landscape reasons.

Basins and ponds store water at the ground surface, either as temporary flooding of dry basins and flood plains, or permanent ponds. These structures can be designed to manage water quantity and quality.

Basins and ponds can be designed to control flow rates by storing floodwater and releasing it slowly once the risk of flooding has passed (a balancing pond).

Basins and ponds treat runoff in a variety of ways:

- settlement of solids in still water - having plants in the water enhances calm conditions and promotes settlement
- adsorption by aquatic vegetation or the soil
- biological activity

Basins and wetlands offer many opportunities for the landscape designer. Basins should not be built on, but can be used for sports and recreation. Permanently wet ponds can be used to store water for reuse, and offer excellent opportunities for the provision of wildlife habitats. Both basins and ponds can be part of public open space.

Onsite Storm Detention Systems

Onsite Stormwater Detention (OSD) is an option where sustainable drainage systems are not practicable due to soil and ground conditions. This is normally achieved by installing large diameter pipes, culverts or tanks. The basic principle of on-site storage is that during heavy rain, surface water run-off from roofs, car parks and large paved areas is directed to a storage tank. Water is stored and normally discharged to main sewer using suitable flow control device. At the end of the heavy rain, the storage tank is typically emptied either through use of a gravity or pumped system, ready for the next storm. Alternatively, stored water can be used for garden irrigation, which involves a pump drawing water from storage tanks/pipes and a filter. An outfall will, however, still be required to avoid overflow if stored water is not fully used.

Planning for SUDs

It is important to consider using SUDS early in the design process. Wherever possible, SUDS should be integrated within the layout of the development site. However, it may be appropriate to develop SUDS over a wider area serving a number of sites, each development making a contribution to the implementation and management costs of off-site SUDS.

The land-take implications of SUDS should be identified early in the design of site layout. The SUDS approach adopted will determine the land requirements, although in some cases this may be zero (e.g. use of permeable paving). A simple contribution to SUDS can be provided by the installation of water butts for new dwellings (thought should be given to the positioning of rainwater down pipes to enable water butts to be installed). These are particularly effective in reducing the impact of heavy summer storms, which can cause flash floods. The land take of SUDS can also be combined with other land uses, such as amenity areas.

The developer should seek the advice of the Environment Agency and County Engineer on the design criteria and performance parameters at the outset. Submission of a technical appraisal of the proposed SUDS will be required to demonstrate it will meet the agreed criteria.

Maintenance Requirements

The satisfactory performance of SUDS depends not only on good design but also adequate maintenance, and provision for this must be made from the outset. Planned maintenance operations are likely to be more intensive during the early establishment of balance ponds, and may include initial de-silting on completion of construction (sand, silt and other construction waste may enter the SUDS whilst construction is ongoing). Vegetated SUDS will require routine maintenance to control growth ranging from regular grass cutting (swales and filter strips) to annual meadow grass cutting (for basins) or longer-term management for the vegetation in ponds.

Code for Sustainable Homes: Surface Water Run-Off

Sur1: Reduction of Surface Water Run-Off from Site

A Mandatory Requirement to meet any Code Level is that peak run-off rates and annual run-off volumes post development must not exceed the previous conditions for the site.

In addition credits can be gained where SUDS are used to provide attenuation of the following percentage of water run-off from hard surfaces depending on the situation of the site:

- 50% in low flood risk areas
- 75% in medium flood risk areas
- 100% in high flood risk areas

An additional credit is awarded if run-off from roofs is also attenuated according to the above criteria.

Sur2: Flood Risk

Credits are awarded for development in low flood-risk areas or for the provision of attenuation measures if the development is in a medium or high flood-risk area.

Flood Risk	Credits
Low	2
Medium with measures	1
High with measures	1

7.3.5 Microclimate

Significant amounts of new development, especially tall buildings can have a marked effect on local climatic conditions. These negative effects can be mitigated through careful consideration of the design.

Avoid creation of wind tunnel effect - this is particularly marked alongside watercourses or where a design creates a canyon effect that funnels winds to cause strong and very localised wind effects. A wind environment assessment for tall buildings over for example 10 storeys (this size of development is likely to be referable to the Mayor) can identify these effects at the design stages. All proposals for tall buildings of this size should undertake a wind environment assessment to compare the wind environment to be created with that existing. The wind tunnel test should be designed to predict the wind velocities occurring in the public realm and accessible landscaped areas for comparison against the Lawson criteria. The Lawson criteria define acceptable windiness for different activities such as sitting, walking and standing.

Avoid creation of deep shadows particularly over water bodies - these can have a significant effect on the biodiversity in the water and consequent hydrological effects.

Improve local climatic conditions by the retention of natural vegetation and well designed landscaping. This can result in reduced wind speeds, appropriate shading and shelter, increased moisture retention and even local cooling of the air. The design should take into account details of surrounding landscape that affect wind patterns and solar gain.

Reducing the likelihood of overheating in developments

It is important to design buildings so that excessive solar gain is minimised. Initially this should be through the orientation of the building. This could include the use of solar shading, louvers and careful tree planting to allow excess sunlight to be blocked out in the summer and allowed entry in the winter. Buildings should be designed with a high thermal mass to ensure that the urban heat island effect is ameliorated in the winter but heat is retained in the winter. The use of green roofs will act to increase the thermal mass of the building.

Un-natural ventilation should be minimised to prevent excess heating of the air surrounding the development. Instead natural ventilation such as operable windows and passive stack ventilation should be maximised.

Code for Sustainable Homes: Health and Wellbeing

Hea1: Daylighting

Credits are awarded when dwellings are designed to ensure that adequate daylighting is provided. Daylighting factors would need to be assessed by a qualified daylight consultant.

Daylighting Factor	Credits
Kitchen >2%	1
Living Room > 1.5%	1 credit
Dining Room >1.5%	for all 3
Study >1.5%	

An additional credit is awarded if all the rooms have a view of the sky.

Conserving natural resources and reducing carbon emissions

7.3.6 Energy

Energy use affects all aspects of sustainable development. Energy is used for transportation, for heating, lighting and ventilation, for the provision of water, for the procurement of materials and for landscaping, construction and demolition, and waste disposal. Energy is a theme that runs through the entirety of this document.

This section of the document will address the issue of energy in buildings. Energy is used to provide building services such as heating, cooling, hot water, lighting and for powering other appliances. Encouraging energy efficient, low carbon development as part of sustainable design is an important part of the UK strategy to reduce emissions.

The Greater London Authority and many London Boroughs require that all development follows the principles of the energy hierarchy, as defined in Green Light to Clean Power: The Mayor's Energy

Strategy: **www.london.gov.uk**

Use less energy

Passive Solar Design

Passive solar design (PSD) is a blend of intuition and simple design rules, which ensures that buildings capture maximum light and heat from the sun whilst acting as a buffer against the worst of the elements.

PSD can only be considered at the design stage; it provides a one-off opportunity to save energy during the lifetime of a building, generally at no cost. In modern housing, up to 20-25% of heating and lighting energy can be saved by the application of PSD principles.

There is sufficient scope within the parameters of PSD to create interesting and varied layouts and townscape. In the case of offices, schools and other public buildings, features with a PSD function such as ventilation stacks and atria can be designed in ways that add interest and character.

The Energy Hierarchy

1. Use less energy	**'be lean'**	• Incorporate passive heating and cooling • Improve insulation
2. Supply energy efficiently	**'be clean'**	• Cut transmission losses through local generation • Use combined heat and power and community heating
3. Use Renewable Energy	**'be green'**	• On site: install renewable energy technologies, such as solar water heating, photovoltaics, biomass heating/ CHP and wind turbines • Off site: Import renewable energy generated elsewhere

It is very important to realise that PSD principles can be applied equally effectively in housing and commercial developments, which have an entirely conventional appearance. For example, a typical 18th century farmhouse could provide a useful design checklist: orientation towards the south, main living room widows in the south façade with splayed side reveals to maximise light penetration, possibly a long north sloping roofline down to single storey rooms at the rear of the house accommodating the kitchen, larder and a few small windows.

The application of PSD will always be constrained to a certain extent by building and location specific factors.

The principles of PSD

Virtually all buildings enjoy free energy and light from the sun; the objective in PSD is to maximise this benefit by using simple design approaches which intentionally enable buildings to function more effectively and provide a comfortable environment for living or working. The following principles of PSD should be applied to a development during the design stages:

- **Orientation** - The capture of solar gain can be maximised by orientating the main glazed elevation of a building within 30 degrees of due south
- **Room layout** - Placing rooms used for living and working in the south facing part of the building will reduce reliance on artificial lighting and heating methods
- **Avoidance of overshadowing** - Careful spacing of buildings should seek to minimize overshadowing of southern elevations, particularly during the winter when the sun is low
- **Window sizing and position** - In housing, smaller windows should generally be used in north facing elevations to prevent excessive loss of heat
- **Natural ventilation** - Atria and internal ventilation stacks projecting above the general roof level can be used to vent air as the building warms during the day, with cool air being drawn in through grills in the building façade
- **Lighting** - In offices the avoidance of deep-plan internal layouts and the use of atria, roof lights and light reflecting surfaces can help reduce the need for artificial lighting
- **Thermal buffering** - In order to reduce heat losses, unheated spaces such as conservatories, green houses and garages which are attached to the outside of heated rooms can act as thermal buffers
- **Landscaping** - Landscaping, including the use of earth bunds, is often used as part of an overall PSD approach providing a buffer against prevailing cold winds and shading for summer cooling. See Section 7.3.5 Microclimate for further information.

Energy Efficiency

The energy efficiency of a building is determined largely by its design, the choice of materials and the choice of plant and equipment. Increasing the energy efficiency of a building will enable a greater proportion of its energy demand to be met by renewable energy and will allow proposers of development to meet higher levels of the Code for Sustainable Homes and councils' integrated renewable energy policy in a more cost effective way.

London Renewables has produced a toolkit for planners, developers and consultants giving detailed guidance and information on incorporating energy efficient and renewable energy technology and design into developments. The toolkit includes technology guides that contain descriptions of energy efficiency measures and technologies to be considered at the earliest stages of design:

- Selection of heating system (includes community heating systems)
- Insulation
- Lighting and appliances
- Glazing
- Ventilation
- Cooling
- Controls

The use of electric heating systems instead of gas powered heating systems results in double the amount of carbon emissions. It is therefore strongly discouraged by many local councils and the GLA. An exception to this may be in the top storeys of very tall buildings, where gas central heating poses a health and safety risk. However, high density buildings of this sort present a perfect opportunity for communal heating, obviating the need for gas on the top storeys and providing further carbon savings.

Code for Sustainable Homes: Energy

Ene1: % improvement on the TER

There is a Mandatory Requirement for the improvement of the Target Emission Rate above Building Regulations, as shown in the table below:

Code Level	% improvement of TER over DER
1	10
2	18
3	25
4	44
5	100
6	True Zero Carbon

This reduction in carbon dioxide emissions can be achieved through both energy efficiency and renewable energy technologies

Ene2: Heat Loss Parameter (HLP)

(The total fabric and ventilation heat losses from the dwelling divided by the total floor area. (W/m^2K).) If the HLP is less than or equal to 1.3 then 1 credit is awarded or if the HLP is less than or equal to 1.1, two credits are awarded.

Ene3: Internal Lighting

Credits are awarded for the proportion of fixed internal light fittings installed which are dedicated to be energy efficient. 40% and more - 1 credit, 75% or more - 2 credits.

Photo: Courtesy of British Wind Energy Association

Use renewable energy

Renewable energy is energy derived from renewable or replaceable resources, such as the sun, wind, water and plant material. Various technologies are suitable for the London area and they should be integrated with energy efficient design and technologies for maximum benefit.

The London Borough of Merton first introduced a planning policy which stipulates that 10% of each new development should reduce predicted CO2 emissions by 10% through the provision of on site renewable energy equipment. The aim of this policy is to reduce the amount of energy used in buildings, which is produced through the burning of fossil fuels. This is an important consideration due to the fact that the burning of fossil fuels causes climate change through the release of carbon dioxide into the atmosphere. Since then many London boroughs have adopted similar policies, some of which now require that 20% of the development's expected carbon emissions are offset through the use of renewables. This is in line with the draft changes to the London Plan.

In order to adhere to such policies, the following approach could be taken:

1. Ensure building is energy efficient by design (e.g. incorporate passive solar design, high levels of insulation etc)
2. Calculate predicted energy (electricity and gas) usage for the building
3. Calculate predicted CO2 emissions associated with the building (using CO2 multiplication values for electricity and gas)
4. Select renewable energy technologies and calculate CO2 emissions offset through their application
5. Calculate % of CO2 emissions offset through use of renewable energy technologies

It is essential that the development is made as energy efficient as possible. This will ensure that the capital outlay for the renewable energy equipment is reduced, as the predicted energy/CO2 emission levels to be offset will be lower.

London Renewables has developed a toolkit to assist developers in understanding the detailed requirements of a building integrated renewable energy policy, ensuring swift passage through the planning process. The Toolkit provides detailed information on the range of renewable energy technologies currently suitable for application in London, including their feasibility for specific development types and their typical capital cost and contribution to carbon dioxide savings. The following renewable energy technologies are addressed:

- Wind turbines
- Photovoltaics
- Solar water heating
- Biomass heating
- Biomass combined heat and power
- Ground source heating
- Ground source cooling/ borehole cooling

Code for Sustainable Homes

Ene7: Low and Zero Carbon Technologies

Credits are awarded if 10 or 15% of the site's total carbon dioxide emissions are offset through the use of low and zero carbon technologies. A feasibility study of low and zero carbon technology options must be completed or low carbon buildings

Supply energy efficiently

Community and District Heating

Community or district heating uses a central boiler plant or building based systems to supply heat to dwellings via insulated underground water mains. The advantages of modern community heating systems are:

- Having one central boiler plant provides greater flexibility to change fuel sources in future, e.g. if gas becomes expensive while biomass fuel sources become cheaper and more widely available.
- Central systems can reduce maintenance costs (and legal bills resulting from access problems) particularly for housing associations or local authorities who are obliged to undertake annual inspections of individual gas appliances.
- Related to the point above, the systems are safer as they avoid combustion appliances in the home, this is especially important in high-rise developments, where gas boilers pose a safety risk on the upper storeys.
- The use of central plant can allow better matching of heat generation to demand resulting in general improvements in efficiency.
- It allows bulk purchasing of fuel, potentially leading to reduced running costs for occupants.
- The heat exchanger unit, which is similar to a conventional wall hung boiler in size does not have to be mounted on an external wall as there is no flue.

A developer considering a community or district heating system

The developer would need to identify or set up a company (such as an Energy Services Company or ESCo) to install, manage and operate the scheme including billing tenants and homeowners for the energy used.

The capital cost of a community heating system, taking into account the installation of the heat main, is likely to be more than individual boilers. The main factor affecting cost is the density of homes and the number of connections that need to be made to the underground heat main. If connections can be kept to a minimum and distribution pipe-work runs above ground where possible, costs can be reduced. For this reason high rise developments are the most suitable for a communal heating system.

A community heating network could be fuelled either by high efficiency gas boilers, biomass fuelled boilers or by a combination of boilers and CHP plant. These options could all be assessed as part of a detailed feasibility study. Biomass would require a reliable supply of appropriate fuel to be sourced.

There are already a considerable number of community heating systems in London and a cost effective option would be to link up with existing schemes that have spare capacity. The Greater London Authority carried out a strategic analysis of where community heating is likely to be most feasible in London due to the existing heat demand. The study shows specific areas where community heating infrastructure could be developed, building on existing networks. The study looked in detail at the Thames Gateway area. It is available to download from: **http://www.london.gov.uk/mayor/environment/energy/docs/comm-heating-summary.pdf**

Combined Heat and Power (CHP)

When electricity is generated in central power stations around 60-65% of the primary energy is rejected as waste heat into the atmosphere often via the familiar cooling towers we see dotted around the landscape. Combined heat and power units generate electricity locally so that waste heat can be used for beneficial purposes. Where all the waste heat generated can be used, CHP units will have overall efficiencies of up to 80-85% compared to 35-40% for conventional power stations. They can be used as standalone units (mini CHP) in a single building or as the primary generator of heat and power for district or community heating schemes.

CHP systems produce roughly twice as much waste heat as they generate electricity. To be viable economically they require a large and constant demand for heat. This can sometimes make their application to energy efficient new housing problematic. Current insulation standards mean the requirement for space heating is very low and demand is present for only part of the year: the only constant source of heat demand is for domestic hot water and in terms of reducing CO2 emissions much of this demand could be met by the use of solar water heating instead (in low rise dwellings). For CHP systems to be economically viable they need to run for at least 4,000 hours per year. They are more suitable for leisure centres with swimming pools and hospitals that have a high, year round heat demand or in mixed use developments with suitable heat demands. However, new housing or office developments may be able to make use of existing CHP schemes nearby.

Decentralised systems

Where a centralised system is not feasible and renewables can not be used to provide all of the heating and cooling requirements the remaining demand should be met through an efficient energy supply. Gas boilers with at least a 90% efficiency rate should be specified.

7.3.7 Materials

During the year 2000, 27.8 tonnes of materials were used by the construction sector in London. Reusing and recycling construction materials is the most sustainable choice. Where new materials are used, consideration should be given to local sourcing, the energy used in their manufacture and their toxicity.

This document does not provide specific guidance on individual material types. More detailed information on common materials can be found in the Green Guide to Specification produced by BRE.

Sustainable and responsible procurement and use of materials

When procuring and using materials, the following should be considered:

- **Maximise the reuse of existing buildings or materials** - existing buildings can be refurbished or extended without the need for substantial use of new materials from primary resources. Alternatively, consider re-use of building materials, such as slate or clay roof tiles, bricks and wooden structural beams that can be safely removed from a building prior to demolition.
- **Reduce waste** - specify and purchase only what is needed for the project
- **Use materials with low lifecycle environmental impacts** - have consideration for the impacts of material extraction, processing, manufacture, transport, use and disposal. This should include considerations of biodiversity impacts such as the use of peat, weatherworn limestone and other materials from vulnerable habitats. This applies to landscaping materials as well as buildings:
  - Minimise use of products containing CFCs, HFCs, PVC and formaldehyde glued chipboard

- Maximise use of recycled materials or materials from sustainable sources (e.g. Forest Stewardship Council [FSC] timber and recycled aggregate which avoids the aggregate levy and the landfill tax)
- Maximise use of materials with low embodied energy - avoid materials such as aluminium, unless a whole life energy or technical case exists for its use
- Use local materials - procure materials locally (wherever practical) to reduce their transportation impacts

- **Maximise the proportion of materials and components that can be re-used at the end of the building's life** - by designing for deconstruction and disassembly. Avoid the use of composite materials where possible.
- **Use an appropriate palette of materials** - specified to support sustainability objectives such as passive solar design and noise attenuation, whilst considering their aesthetic qualities

Maximising the re-use of existing buildings

All planning authorities require that development proposals should demonstrate that there are no existing buildings that could be adapted for the intended purpose where its reuse conforms to or has the potential to meet the standards for energy, materials and water conservation set out elsewhere in the council's policy documents. When re-using existing buildings the following things should be taken into consideration:

- Maximise the re-use of the buildings including the basements and roof spaces;
- Investigate the opportunities to incorporate mixed-uses within buildings, particularly public access uses (retail, leisure etc) at ground floor level;
- Where other policies allow, consider increasing the floor-space of the existing building through additional floors and/or extensions;
- Review the function of any open land within the site, considering opportunities, for example, to remove surface vehicle parking.
- Ensure that the works do not restrict the occupation of the building by other uses in the future, i.e. create a building with greater flexibility for future re-use.

Using pre-fabrication and modular construction techniques

Consider the use of pre-fabricated elements in order to reduce total energy used in the construction phase, speed up assembly, improve quality and minimise defects and wastage. The source location of pre-fabricated elements should be considered in order to minimise transportation.

Standardised or modular designs of components can reduce waste, while "just in time" construction techniques ensure that only materials that are needed immediately are kept on site. Stockpiling materials can increase likelihood of damage or deterioration.

Architects and developers can incorporate many of these material selection principles into their contractor briefs.

Designing new buildings for flexible use

Changing economic, social or environmental demands, climate change, and the introduction of new technology can result in the original use of a building being no longer viable and its heating, lighting and ventilation systems requiring modernisation. Where buildings are designed for flexible use, the need for complete renovation (and the use of vast quantities of new materials) will be removed.

Ground floors are particularly suited to changes of use. Flexibility can be achieved by designing spaces which can be put to alternative purposes.

Design attributes that contribute to achieving flexibility include:

- Use of a grid structure to provide a consistent and generic internal environment
- Use of non-load bearing partitions;
- Integration of additional service capacity and ceiling heights to facilitate changes of room use and servicing requirements.

Specifying materials that do not contain or emit toxic substances during building occupation

Internal air quality can be significantly improved by the use of natural rather than synthetic products. Solvents and other chemicals can have a negative impact on indoor air quality: low solvent finishing products should be used whenever possible (paints, varnishes etc). Some construction materials, furnishings and carpets can also emit substances that affect people's health (e.g. formaldehyde). Care should be taken to provide adequate ventilation to remove these chemicals where their use is deemed essential.

Code for Sustainable Homes: Materials

Mat1: Environmental Impact of Materials

Mandatory Requirement: At least 3 of the 5 key building materials must be A+ to D rated according to the Green Guide to Specification (BRE). Additional credits are awarded the higher the rating of the material.

Mat2:Responsible Sourcing of Materials – Basic Building Elements

Credits are available if the key building materials are responsibly sourced (i.e. Forestry Stewardship Council accreditation or EMS certification)

Mat3: Responsible Sourcing of Materials – Finishing Elements

Credits are awarded were the finishing elements are responsibly sourced. To gain credits under Mat2 and Mat3 evidence must be provided for the complete supply chain of the materials. In order to minimise the cost of gaining this credit a full review of supply chains should be carried out.

7.3.8 Water

London is amongst the driest capital cities in the world and the effects of climate change are likely to further reduce supply and increase demand. Buildings and landscaping are major water consumers and, therefore, building design should incorporate measures to avoid water wastage. Appropriate specification of bathroom and kitchen devices and appliances can help to achieve major savings in water consumption throughout the life of the building. Larger developments can also make use of water recycling systems or underlying groundwater resources to provide water for certain functions (eg. toilet flushing).

Incorporating water saving devices

A range of products encourage sustainable water use, including:

- Low flush toilets
- Waterless urinals
- Urinal controls
- Spray taps
- Automatic shut-off taps
- Water meters
- Water management software
- Flow controllers
- Flow restrictors
- Leakage detection equipment
- Data loggers
- Pressure reducing valve controllers

Making use of alternative water sources where possible

Grey Water Recycling

Water from basins, kitchens and food service locations that is slightly soiled can be used for toilet and urinal flushing, cooling tower or boiler make-up water, landscaping and on-site water storage for fire fighting. Such systems require dual piping to route the grey water and appropriate valves, filters and signage.

Countries outside the UK have already realised the benefits of recycling grey-water. In Tokyo, grey water recycling is mandatory for buildings with over 30,000m2 of floor space or with a potential water reuse of more than 100m3 per day.

It is also possible to recycle black-water (water used for toilet flushing and washing up) by passing it through a black-water recycling system that breaks down solids and purifies the water ready for reuse. Black-water recycling can have high maintenance costs and can be impractical to use on confined sites. Both grey- and black-water systems should be checked for functionality and certified safe.

Rainwater Harvesting

Rainwater harvesting is the collection of rainwater that would otherwise have entered the drainage system, the ground or been lost to the atmosphere through evaporation. Large surfaces such as roofs are ideal for rainwater harvesting and the water captured can be used to flush toilets, water gardens/ landscapes and supply washing machines. Once captured, the water undergoes a multi-stage cleaning process.

Systems should be connected to the mains supply to ensure that water is always available, even at times of low rainfall. SUDS can also be integrated with rainwater harvesting schemes although it cannot be relied upon to provide water attenuation during storms.

The facilities for both rainwater harvesting and grey-water recycling require maintenance to ensure they work properly and do not cause deterioration of water quality. Where possible, facilities should be designed and scaled to be managed under a maintenance contract. Model maintenance agreements for rainwater harvesting and grey-water systems are available from CIRA: www.ciria.org.uk. Future maintenance arrangements should be addressed in the earliest project planning stages.

Groundwater extraction

Sourcing groundwater from boreholes will help to reduce the problems of rising groundwater to Central London. Water from boreholes is generally at a stable and relatively low temperature (around 13oC) and can be used for cooling (replacing traditional refrigeration) although not at low enough temperature to provide dehumidification. Water from boreholes can also be used as grey-water. However, water quality varies across London and regular monitoring is required for compliance with Environment Agency regulations. Also, with increasing drier summers and higher temperatures, ground water cooling may not be a reliable or sufficient source of cooling in the future.

Local packaged sewage treatment systems

Local packaged sewage treatment systems can be utilised for large new developments. These have been successfully used to significantly reduce water consumption and underground water losses.

Code for Sustainable Homes: Water

Wat1: Internal Potable Water Use

Mandatory Requirement: Internal potable water consumption should be reduced to the following no. of litres per person per day to achieve each Level of the Code:

Code Level	Internal Potable Water Consumption
1 & 2	120 litres/person/day
3 & 4	105 litres/person/day
5 & 6	80 litres/person/day

105 litres can be achieved through the use of water efficient sanitary ware, however to achieve 80litres per person per day either grey-water recycling or rainwater harvesting would be required.

Wat2: External Potable Water Use

An additional credit is available for the installation of a collection system for irrigating landscaped areas in the development. If there is no landscaped areas then the credit is automatically awarded. A water butt or rainwater harvesting system would meet this requirement.

7.4 Ensuring comfort and security in and around the development

7.4.1 Internal air quality

Exposure to airborne pollutants released from within buildings can result in health impacts including Sick Building Syndrome - a complex problem caused by a range of factors. The most common symptoms are eye irritation and respiratory problems.

A number of causes can be identified for adverse health within buildings:

- Asbestos - Inhalation of fibres can cause scarring of lung tissue and an increased risk of developing lung, chest and abdominal cancer
- Volatile Organic Compounds (VOCs) - Released from many synthetic materials, furnishing and chemical products. Many VOCs are respiratory irritants.
- Carbon Monoxide - Problems arise with poorly maintained equipment, when chimneys or flues are blocked, or if there is insufficient ventilation to supply air to the appliance or where air intakes are located too close to roads or areas used for car parking.
- Fine Particles - less than 10_m in diameter can cause irritation and respiratory problems.

Mitigation for prevention of these problems is needed by design.

Indoor air quality particularly in office buildings can be improved by the appropriate use of building energy management systems to control the mix of supply and extract air. Air handling unit filtration and pollution sensors can control both internal and external air to prevent the build up of CO2 inside buildings by diluting with external air and the ingress of high pollution levels.

Code for Sustainable Homes: Pollution

Pol1: Global Warming Potential of insulants

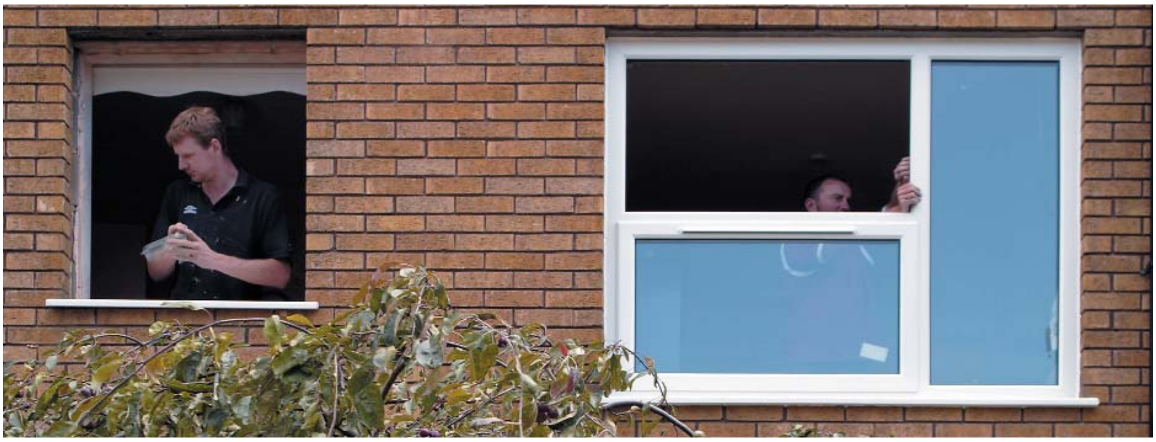
All insulants should have a Global Warming Potential (GWP) of less than 5 to score a credit. Insulants such as glass mineral wool or fibre, expanded polystyrene and polyurethane insulation would have a GWP of less than 5.

7.4.2 Natural light

A lack of natural lighting in winter can have adverse health effects. Office environments may need artificial lighting supplemented in winter with light stimulation in the ultraviolet 280-400nm range. Development of deeper building plots, where natural light cannot penetrate, should include internal atriums and at the smaller scale, sun pipes, directing sunlight into the building.

Control artificial lighting with high frequency control gear by daylight sensors. These can dim or switch off artificial lighting when daylight levels achieve the specified illumination levels. This system will significantly reduce artificial lighting energy consumption and heat gains.

Photo: Tony Sleep



7.4.3 Accessible to all

Many buildings and environments are still not designed to accommodate the wide-ranging needs of disabled people, people with young children and older people. Access needs are often an afterthought, added on at a late stage of the detailed design, rarely included as a requirement in the initial brief at the beginning of the process and resulting in undignified, segregated and inferior provision.

Many councils and the GLA require that accessibility standards exceed those currently addressed in Building Regulations, for example:

- All development should meet the principles of inclusive design; to be used safely and easily by as many people as possible without undue effort, separation, or special treatment;
- New development should be accessible for people walking and cycling and travelling by public transport;
- Safe and convenient pedestrian, cycle and wheelchair access should be provided into the site and pedestrian and wheelchair access into the building and around the site itself;
- Appropriate convenient access should be provided within buildings for both the occupiers and visitors. Measures to facilitate such access should not be separate from general access arrangements.
- E-enabling by the use of IT systems to facilitate virtual access should be considered

Code for Sustainable Homes: Health and Wellbeing

Hea4: Lifetime Homes

4 credits are available for implementing the principles of the Lifetime Homes scheme. The standards can be found at: **http://www.lifetimehomes.org.uk/pages/16_lth_standards.html**

7.4.4 Secure design of developments

The adoption of urban design principles can contribute significantly to a safer environment. Development schemes could incorporate measures in their design, layout, siting and landscaping to minimise the risk of crime and maximise security. This may enable the development to gain the Secured by Design Award which is sometimes required by local authorities and which earns credits under the Code for Sustainable Homes Health and Wellbeing section. Blank walls and parts of buildings such as loading bays, that cannot contribute to passive surveillance, should not face onto public space but should be placed at the backs of blocks. The adoption of the ‘perimeter block’ layout can support these measures, comprising frontages where the public realm is readily overlooked from adjacent properties and the rear gardens are private secure areas which are difficult for third parties to access.

The following issues should be considered when designing a safe development:

- Opportunities to incorporate passive surveillance of streets, spaces, parking and servicing areas
- A ‘perimeter block’ approach wherever practicable and appropriate
- Strong demarcation between public and private space
- Public areas are well lit and landscaping does not obscure views into and out of the space
- Developments are constructed of vandal resistant materials, and that maintenance arrangements are in place
- Installation of sprinkler systems and hard wire smoke alarms where feasible.

Code for Sustainable Homes: Management

Man4: Security

2 credits are available for gaining the Secured by Design Award for the development, this would require an architectural liaison officer or crime prevention design advisor to be consulted at an early design stage.

7.4.5 Safe routes to public transport

Developments that will impact upon public transport provision, either through the creation of new routes or by increasing its usage should seek to ensure that access is:

- Clearly marked and easily accessible by all sections of society;
- In a location that is overlooked by active frontages, on well-used and well-lit routes
- Away from landscaping and other vegetation that could provide screening.

7.4.6 Safe and secure parking for personal transport

Development proposals can contribute to safety by ensuring that access to parking, servicing and storage areas are safe and secure. This can be achieved through:

- Locating surface parking areas within the private defensible space of a residential development on the street or in a well surveyed parking court overlooked by active building frontages
- Ensure that parking, servicing and storage areas for cars, bicycles and other means of personal transport are well illuminated
- Wherever possible providing bicycle facilities inside a building or close to the main entrance, lit and unobstructed
- Designating bays for disabled people and people with small children close to the main entrance of buildings

7.4.7 Principles of flood resistant design (where applicable)

The Environment Agency is developing the concept of flood compatible and flood resistant development. Some forms of development may need to be beside rivers. These should be designed so that they can be flooded without causing any undue damage.

In other areas development can be designed to be flood resistant. For example putting living accommodation on the first floor or building on stilts. Roof drainage can also be designed to cope with the higher levels of rainfall and increased occurrence of storms expected from climate change.

Internal flood resistant design measures include:

- Solid floors rather than suspended floors
- Use treated timber to resist waterlogging or marine plywood for shelves and fittings
- Fit electric, gas and phone circuits above expected flood level
- Fit one-way auto seal valves on WCs
- Use water resistant alternatives to traditional plaster or plasterboarding for internal wall finishes
- Do not use chip board or MDF (eg in kitchen units)
- Avoid fitted carpets on ground floor

8

Sustainable Construction

8.1 Minimising the adverse effects of the construction process on site and surroundings

Many aspects of the construction process can have a significant adverse impact on the quality of the site and its surroundings. Through careful and considerate planning, these impacts can be reduced.

Applying the waste hierarchy during construction

As part of the construction phase the treatment of waste is a crucial issue. The waste hierarchy provides a framework for sustainable waste management that is applicable during the construction phase. The adverse effects of construction can be minimised by the preparation a site waste management plan in line with this hierarchy:

- Reduce waste by specifying and purchasing only what is needed for the project
- Sort waste streams to maximise recycling and reuse of waste and decrease landfill costs

Code for Sustainable Homes: Waste

Was2: Site Waste Management Plan/ Construction Waste

Mandatory Requirement: A Site Waste Management Plan including monitoring of waste generated on site and the setting of targets to promote resource efficiency must be produced and implemented.

Additional credits are awarded for including procedures and commitments for:

- Minimising waste
- Sorting, re-using and recycling waste

Managing air quality

Identify potential sources of dust and other air pollution as early as possible and implement the following dust control measures:

- Activities that may affect air quality or generate dust should be located away from sensitive human receptors (e.g. hospitals, schools, housing) and ecological resources whenever possible.
- Completed earthworks should be sealed or replanted as early as practicable.
- Where practicable, stockpiled materials should be located to take account of the prevailing wind and any sensitive receptors. Stockpiles should be dampened.
- Dust sources such as skips should be covered.
- Roadways (including haul roads), construction sites and dust generating activities such as stone cutting should be dampened and swept when required.
- Sites should be designed to accommodate wheel washer facilities as appropriate.
- Low emission vehicles and plant equipment should be used particularly for on-site generators.
- Controls also need to be in place during demolition. Dampening down during demolition activities can assist with preventing dust pollution.

Using energy efficient and low emission equipment

Equipment should be as efficient as possible and well maintained to minimise energy use and emissions. This includes the vehicles that transport materials and personnel to and from site.

Photos: Tony Sleep

Minimising construction noise

Construction noise and disruption should be minimised through the specification of techniques such as the use of framed construction and pre-fabricated components. These can reduce some of the noise impacts associated with both the transportation and use of materials. Construction activities should be planned to limit both the level and duration of noise, to minimise disturbance to premises and amenities in the area. Consultation with Borough Environmental Health Officers (EHO) is needed at an early stage.

Code for Sustainable Homes: Management

Man2: Considerate Constructors Scheme

Credits are awarded where the development contractors comply with the best practice site management principles outlined in Considerate Constructors or an alternative scheme.

- 1 credit for Best Practice score of between 24 and 31.5
- 2 credits for Best Practice score of between 32 and 40

Building green

Composting organic wastes on site can supplement topsoil for landscaping and also conserve topsoil on site with as little disturbance as possible.

Protecting biodiversity

CIRIA has prepared biodiversity indicators for construction, which involve an assessment of the construction process. Areas of existing value that are to be kept and enhanced must be secured from harm during construction, including existing trees and waterside zones, preferably through being fenced securely. Other impacts to be avoided should include soil compaction, and pollution of soils and water. Where construction activities require temporary access over, or removal and replacement of, habitat these operations should be supervised by trained staff, or a qualified ecologist.

Where protected species are involved there may be a statutory requirement for obtaining a licence and the work may need to be undertaken in a particular season. Such restrictions can be quite wide (for example all nesting birds are protected from disturbance under the Wildlife and Countryside Act 1981, as amended).

Code for Sustainable Homes: Management

Man3: Construction Site Impacts

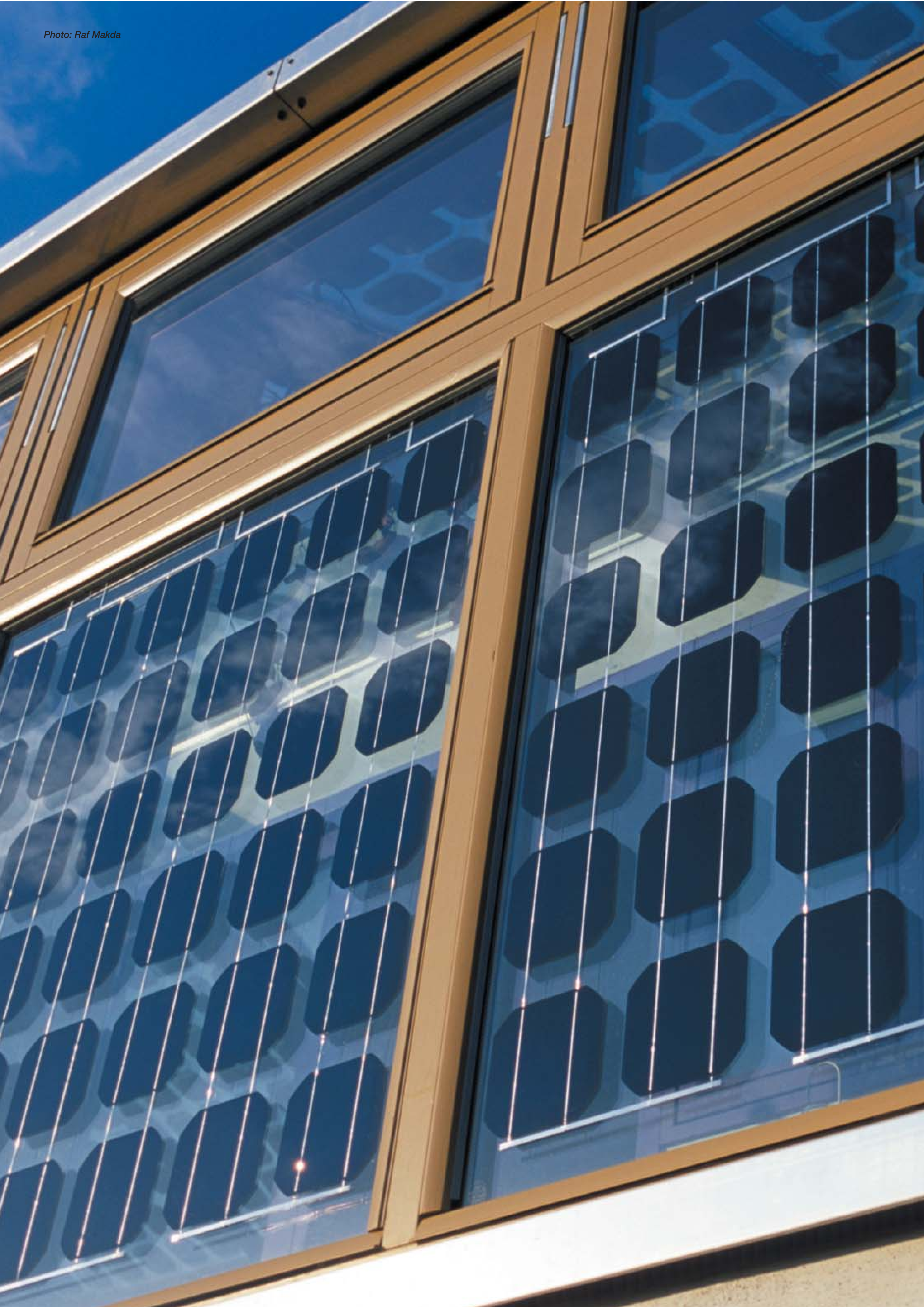
Credits are awarded for monitoring, reporting and setting targets for:

- CO2 /energy use from site activities
- CO2 /energy use from site related transport
- Water consumption from site activities

Adopt best practice policies in respect of:

- Air (dust) pollution from site activities
- Water (ground and surface) pollution
- 80% of site timber is responsibly sourced

Photo: Raf Makda



9

Sustainable Living

9.1 Encouraging sustainable living through building design and information provision

Through constructing buildings that are sustainable in design we are allowing the building's inhabitants to lead more sustainable lives. Building occupiers will experience lower fuel and water bills, healthier living conditions and draw comfort from the fact that they are helping to protect the environment.

While responsible development can ensure that resources are protected and carbon emissions reduced over the lifetime of the building, occupiers can deliver further environmental benefits by choosing to live sustainable lifestyles. However, without the provision of appropriate facilities or information, these options can be restricted or even withdrawn altogether.

By providing recycling facilities, bicycle storage and operational information for building services, developers will ensure that occupiers use the building - and live their lives - in the most efficient and sustainable way.

9.1.1 Promoting sustainable waste behaviour

London produces approximately 17 million tonnes of solid waste every year. Of this, councils collect 4.4 million tonnes from households and commercial and industrial sources as "municipal waste". Household waste accounts for three-quarters of the total municipal waste.

The vast majority of London's municipal waste is currently disposed of in landfill. In 2002/03, landfill accounted for 71 per cent of municipal waste, with around 90 per cent of this going to sites outside Greater London. A further 20 per cent of London's municipal waste is incinerated at the two waste incineration plants within London, at Edmonton and Lewisham, where the process generates electricity.

The design of a development is critical to ensure that sustainable waste management can be achieved. Without adequate waste and recycling storage facilities, people are unable to develop efficient sustainable waste procedures in their homes, schools or workplaces.

Sustainable waste management

Sustainable waste management involves producing less waste, and dealing better with the waste that is produced. The waste hierarchy provides a framework for sustainable waste management:

- Reduce (the amount of waste generated)
- Reuse
- Recycle
- Recovery (of energy and materials)
- Disposal (least desirable option)

Designing for waste

Integration of sustainable waste management principles into design includes:

- Storage and recycling facilities - Design of suitable individual or shared waste sorting and recycling facilities (such as storage bins in kitchens and integrating recycling bins or composting areas into the building or site fabric). Provision of local shared recycling facilities for new residential or mixed use developments
- Composting - Provision of a composting facility in properties with gardens or landscaped space.

Code for Sustainable Homes: Waste

Was1: Household Waste Storage

Mandatory Requirement: Sufficient space must be provided externally to hold the larger of the local authority waste and recycling bins provided.

4 credits are also awarded if the ALL the following criteria are satisfied:

- Internal storage for three recycling bins and a landfill waste bin (30l) is provided
- There is a local authority collection scheme from the site or a private contractor which collects 3 types of waste or greater
- 180litres of external recyclable waste storage is provided

OR

- Where there is no external recyclable waste storage 2 credits can be gained if 60litres of internal storage is provided.

OR

- Where there is external recyclable waste storage OR a local authority collection scheme 4 credits can be gained if internal storage of 30 litres is provided.

Was3: Composting

One credit is awarded where a community/communal composting service, either run by the local authority or overseen by a management plan is in operation. If the dwelling has a private garden then a composting bin will be sufficient to gain this credit.

9.1.2 Travel Plans

Carbon dioxide emissions from petrol-based transport are one of the contributors to greenhouse gas emissions and hence climate change.

Car-free housing should be provided in locations that can support it. If residential developments which are not car-free are provided in those locations, additional measures to encourage use of sustainable transport options should be taken.

A Travel Plan is a package of measures and initiatives that aim to reduce the number of car journeys made, by providing people with greater choice. When designing a new development it is important that sustainable transport is encouraged through the development and implementation of a travel plan. All local authorities within London are required to have a travel plan and many will be making this a planning policy requirement.

Facilities can be provided in developments to support different transport modes such as the provision of bicycle racks and secure storage or charging points for electric cars. Workspaces with showers should also be considered.

The development should include a network of safe pedestrian and cycle routes which follow desire lines, safe crossing points across all roads and the design of pavements to enhance the interaction of people.

Code for Sustainable Homes: Energy

Ene8: Cycle Storage

Credits are awarded for the provision of weather-proof and secure cycle storage

- 1 credit is awarded if 1 cycle space is provided for each 1-, 2- and 3- bedroom dwelling and 2 spaces are provided for 4 or more bedroom dwellings
- 2 credits are awarded for 1 cycle space for a 1-bed dwelling, 2 cycle spaces for a 2- or 3-bed dwelling and 4 spaces for a 4 or more bed dwelling.

Ene9: Home Office

If a suitable place for a home office is provided to reduce the need to commute to work. Requirements are a room with a:

- 1.8m wall to allow a desk and filing cabinet to be installed
- 2 power sockets
- 2 telephone points
- Window
- Adequate ventilation

9.1.3 Information provision

Where a development has been designed with care and consideration for its occupiers and the environment, it is essential that developers provide comprehensive information and advice for its ongoing management. This will ensure that the development is used in the correct way and that sustainable design features deliver maximum benefits.

Code for Sustainable Homes: Management

Man1: Home User Guide

A non-technical guide should be provided for the home-occupier. Credits are available for covering the following topics in the guide:

- Operational issues
- Site and surroundings

9.1.4 Promoting reduction in energy use

Code for Sustainable Homes: Energy

Ene4: Drying Space

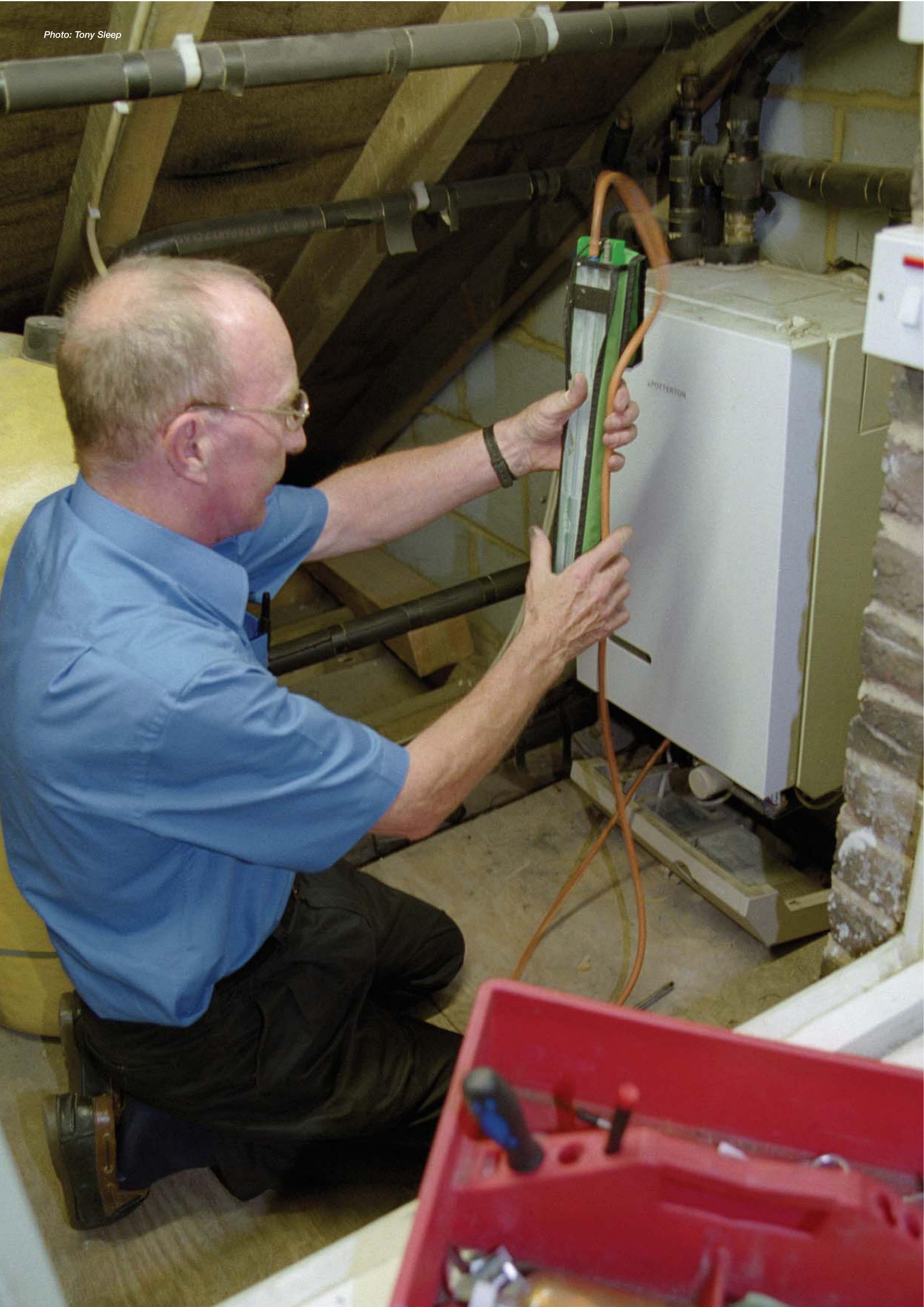
- One credit is awarded for the provision of a drying line within the dwelling or in the private garden to reduce the need for tumble dryers.
- For 1- or 2-bed dwellings the line should measure 4m+, for 3 or more bed dwellings the line should be 6m+.

Ene5:Energy Labelled White Goods

If white goods are provided by the developer:

- 1 credit is awarded if EU Energy Efficient labelled A+ Fridges and Freezers are provided AND/OR A rated washing machines and dishwashers
- An additional credit is awarded if B rated washer dryers and tumble dryers are provided.
- If no white goods are to be provided a credit is available for the provision of information on EU Energy Efficiency Labelling.

Photo: Tony Sleep



10 Appendix B

Directives, policy statements and building regulations on sustainable design and construction

Principle	EU/ CLG Publication
Ensuring land is safe for development	● Planning Policy Statement 23: Planning and Pollution Control ● Building Regulations, Part C – Site preparation and resistance to moisture
Ensuring access to and protection of the natural environment	● Planning Policy Guidance 17: Planning for Open Space, Sport and Recreation ● Planning Policy Guidance 9: Nature conservation
Reducing negative impact of development on the local environment	● Planning Policy Guidance 24: Planning and Noise ● Building Regulations, Part E – Resistance to the passage of sound
Conserving natural resources and reducing carbon emissions	● EU Energy Performance of Buildings Directive ❍ Energy Performance Certificates: HIPs for all dwellings at the time of sale or rent from June 2007 ❍ All large public buildings to permanently display an energy performance certificate ❍ All major planning proposals to consider community heating ● Supplement under consultation to form PPS1: Delivering sustainable development ● Planning Policy Statement 23: Renewable Energy (Companion Guide to PPS22) ● The Planning Response to Climatic Change; Advice on Better Practice. ODPM/ Welsh Assembly/ Scottish Executive ● Building Regulation, Part L – Conservation of Fuel and Power Updated Building Regulations L1A (2006) – Conservation of fuel and power in new dwellings. 5 criteria to meet: ● Criterion 1: Predicted CO2 emissions no worse than target (DER ≤TER) ● Criterion 2: Design limits – e.g. minimum requirements for U-values and air permeability ● Criterion 3: Limiting the effects of solar gains in summer ● Criterion 4: Quality of construction & commissioning of heating systems (e.g. reduce thermal bridges, procedure for air pressure testing and commissioning) ● Criterion 5:Operating and maintenance instructions
Ensuring comfort and security in and around the development	● Building Regulations, Part F - Ventilation ● Building Regulations, Part M - Access to and Use of Buildings ● Safer Places – the Planning System and Crime Prevention. ODPM and Home Office
Minimising adverse effects of the construction process on site and surroundings	N/A
Encouraging sustainable living through building design and information provision	N/A

11 Appendix C

Useful websites

Sustainable Construction: Practical guidance for planners and developers - which aims to assist in the task of delivering more sustainable buildings. This is the outcome of a research project core funded by the DTI. Visit **www.sustainable-construction.org.uk** to access information on sustainable design and construction measures and training materials.

Other useful websites include:

Name	Website
Association for Environmental Conscious Building	www.aecb.net
Beddington Zero Energy Development	http://www.peabody.org.uk/pages/GetPage.aspx?id=179
Building Research Establishment	www.bre.co.uk
CABE	www.cabe.org.uk
Carbon Trust	www.thecarbontrust.co.uk
Centre of Excellence for Sustainables Building	www.sustainable.doe.gov
Chartered Institution of Building Services Engineers (CIBSE)	www.cibse.org.uk
CIRIA	www.ciria.org.uk
Combined Heat and Power Association	www.chpa.co.uk
Constructing Excellence	www.constructingexcellence.org.uk
Energy Saving Trust	www.energysavingtrust.org.uk
Green Building Store	www.greenbuildingstore.co.uk
High performance maps for facades	www.fabermaunsell.com
Housing Corporation	www.sustainabilityworks.org.uk
Integer	www.interproject.co.uk
LEARN: Low Energy Architecture Research Unit	www.learn.londonmet.ac.uk
Lifetime Homes	www.lifetimehomes.org.uk
Living roofs	www.livingroofs.org
London Biodiversity Partnership	www.lbp.org.uk
London Energy Partnership	www.lep.org.uk
London Hydrogen Partnership	www.lhp.org.uk
London Sustainability Exchange	www.lsx.org.uk
SPONGE Sustainability network	www.spongenet.org
Sustainable Homes	www.sustainablehomes.co.uk
Tall Buildings	www.cityoflondon.gov.uk
UK Green Building Council	www.ukgbc.org
UK Government Sustainable Development	www.sustainable-development.gov.uk

12

Appendix D

Putting a Price on Sustainability: Study Results

Naturally ventilated office - percentage increases in capital cost

Location	BREEAM score (and rating) for the base case	% increase for pass	% increase for good	% increase for very good	% increase for excellent
Poor	25.4 (pass)	0%	0%	2%	-
Typical	39.7 (pass)	-	0%	0%	3.4%
Good	42.2 (good)	-	-	0%	2.5%

Note: A small overall cost saving was identified resulting from the removal of air conditioning equipment in the computer/ server room thereby enabling increased performance at no extra cost

Air conditioned office - percentage increases in capital cost

Location	BREEAM score (and rating) for the base case	% increase for pass	% increase for good	% increase for very good	% increase for excellent
Poor	20.3 (unclassified)	0%	0.2%	5.7%	-
Typical	34.6 (pass)	-	0%	0.2%	7.0%
Good	37.1 (pass)	-	0%	0.1%	3.3%

Domestic dwelling - percentage increases in capital cost

Location	BREEAM score (and rating) for the base case	% increase for pass	% increase for good	% increase for very good	% increase for excellent
Poor	22.1 (unclassified)	0.1%	0.9%	3.1%	-
Typical	27.6 (unclassified)	0%	0.4%	1.7%	6.9%
Good	29.7 (unclassified)	0%	0.3%	1.3%	4.2%

LIFT health centre - percentage increases in capital cost

Location	BREEAM score (and rating) for the base case	% increase for pass	% increase for good	% increase for very good	% increase for excellent
Typical	44.3 (good)	-	-	0%	1.9%
Good	48.4 (good)	-	-	0%	0.6%

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LDSA

LABC